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Title : IEC 61097-2: Global maritime distress and safety system (GMDSS) - Part 2: COSPAS-SARSAT EPIRB -Satellite emergency position indicating radio beacon operating on 406 MHz - Operational and performance requirements, methods of test and required test results

Introductory note: A revision of edition 1 to take into account changes to the COSPAS SARSAT requirements and changes to the ITU recommendations. The normative references have been updated and some details have been altered to bring the requirements in line with those in the US-RTCM standard -however the rest of the document remains unchanged

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 61097-2 edition 2 has been prepared by working group 8, of IEC technical committee 80:

The text of this standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until _____. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS) -

Part 2: COSPAS-SARSAT EPIRB - Satellite emergency position indicating radio beacon operating on 406 MHz - Operational and performance requirements, methods of testing and required test results

1 Scope

This part of IEC 61097 specifies the minimum performance requirements, technical characteristics and type-testing requirements of the satellite emergency position indicating radio beacon used in the COSPAS-SARSAT satellite system (satellite EPIRB), as required by Regulation IV/7.1.6 of the 1988 amendments to the 1974 International Convention for Safety of Life at Sea (SOLAS), and which is associated with IEC 60945 (General requirements). When a requirement in this standard is different from IEC 60945, the requirement in this standard shall take precedence.

This standard also includes minimum performance standards for a manually activated satellite EPIRB without float-free release mechanism (see annex C).

This standard incorporates the performance standards of IMO Resolutions A.810(19) *Performance Standards for float-free satellite emergency position-indicating radio beacons (EPIRBs) operating on 406 MHz* and A.662(16) *Performance Standards for float-free release and activation arrangements for emergency radio equipment*, the International Telecommunication Union (ITU) Radio Regulations as well as the technical characteristics for such transmitters contained in Recommendation ITU-R M.633- (as amended), and takes account of the general requirements contained in IMO Resolution A.694(17).

All texts of this standard, whose wording is identical to that in the IMO SOLAS Convention 1974 as amended in 1988 and Resolutions A.658(16), A.662(16), A.689(17), A.694(17), A.696(17), A.702(17) and A.810(19)and Recommendation ITU-R M.633 will be printed in italics and the Resolution/Recommendation and paragraph number indicated between brackets.

NOTES

1 Classes of satellite EPIRB's considered in this document are:

- Class 1: Float-free (-40 °C to +55 °C). The float-free release mechanism (A.662(16)) shall be capable of operating throughout the temperature range of -40 °C to +65 °C.

  This class is not required by IMO Resolutions but (633) *may be applied at the discretion of each Administration*.

- Class 2: Float-free (-20 °C to +55 °C). The float-free release mechanism (A.662(16)) shall be *capable of operating throughout the temperature range of -30 °C to +65 °C.*

2 Non-float-free, manually activated satellite EPIRB's in both classes are considered in annex C.

3 All classes shall include a 121,5 MHz homing device, described in annex D.

User experience of COSPAS-SARSAT EPIRB operation leading to some clarification of IMO performance standards, and providing some useful information for satellite EPIRB users is included in annex E.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent

amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60945, *Marine navigational equipment - General Requirements - Methods of testing and required test results*

IMO Resolution A.658(16): 1989, *Use and fitting of retro-reflective materials on life-saving appliances*

IMO Resolution A.662(16): 1989, *Performance standards for float-free release and activation arrangements for emergency radio equipments*

IMO Resolution A.689(17): 1991, *Testing of life-saving appliances*

IMO Resolution A.694(17): 1991, *General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids*

IMO Resolution A.696(17): 1991, *Type approval of satellite emergency position-indicating radio beacons operating in the COSPAS-SARSAT system*

IMO Resolution A.702(17): 1991, *Radio maintenance guidelines for the global maritime distress and safety system (GMDSS) related to sea areas A3 and A4*

IMO Resolution A.810(19): 1995, *Performance standards for float-free satellite emergency position-indicating radio beacons (EPIRBs) operating on 406 MHz*

Recommendation ITU-R M.633, *Transmission characteristics of a satellite emergency position-indicating radio beacon (satellite EPIRB) system operating through a low polar-orbiting satellite system in the 406 MHz band*

Recommendation ITU-R M.690, *Transmission characteristics of emergency position indicating radio beacons (EPIRB's) operating on carrier frequencies of 121,5 MHz and 243 MHz*.

COSPAS-SARSAT
C/ST.001, as amended, *Specification for COSPAS-SARSAT 406 MHz distress beacons and*
C/ST.007, as amended, *COSPAS-SARSAT 406 MHz distress beacon type approval standard*

IMO Safety of Life at Sea (SOLAS) Convention 1974, as amended in 1988 (GMDSS)

3 Performance requirements

3.1 General

In addition to this performance Standard, the satellite EPIRB shall comply with the requirements of COSPAS-SARSAT documents C/S T.001 and C/S T.007, as amended.

(A.810(19)/A.1) *The satellite emergency position-indicating radio beacon (EPIRB)* shall, *in addition to meeting the requirements of the Radio Regulations, the relevant ITU-R Recommendations and the general requirements set out in resolution A.694(17) comply with the following performance* Standard.

The radio frequency of operation of the equipment shall at all times be within the limits defined by the Radio Regulations

3.1.1 The satellite EPIRB shall be (IV/7.1.6.3) *ready to be manually released and capable to be carried by one person into a survival craft.*

3.1.2 (A.810(19)/A.2.1) *The satellite EPIRB* shall *be capable of transmitting a distress alert to a polar orbiting satellite*.

3.1.3 It shall be designed to operate according to this standard when floating in the sea and shall also be capable of operating on board a ship and on a survival craft.

3.1.4 (A.810(19)/A.2.2) The satellite *EPIRB* shall *be of an automatic float-free type. The equipment, mounting and releasing arrangements* shall *be reliable and operate satisfactorily under the most extreme conditions likely to be met with at sea*.

3.1.5 (A.662(16)/1*) Float-free release and activation arrangements* shall *enable the automatic release of the satellite EPIRB from a sinking ship and its automatic activation*.

3.1.6 (A.694(17)/1.2) *Where a unit of equipment provides a facility which is additional to the minimum requirements of this* standard, such an E.P.F.E. (Electronic Position Fixing Equipment) or the possibility of connecting external data, *the operation, and as far as is reasonably practicable, the malfunction of such additional facility* shall *not degrade the performance of the equipment below those minimum standards.* The additional facility shall, as a minimum, meet the appropriate requirements of of IEC 60945, as applicable. Where such an additional facility exists, it shall not prevent the satellite EPIRB fully conforming to the requirements of this standard during normal combined operation.

3.1.7 The satellite EPIRB shall be a single integral unit. No part of it shall be detachable without the use of tools.

3.2 Operational

The satellite EPIRB shall:

3.2.1 (A.810(19)/A.2.3.1) *Be fitted with adequate means to prevent inadvertent activation* and deactivation. For instance, manual activation shall require two simple but independent movements, neither of which on its own shall activate the satellite EPIRB.

3.2.1.1 If the satellite EPIRB is designed to activate automatically when it is manually removed from its release mechanism, the low-duty cycle light (3.2.11) shall begin flashing within 2 s, in any lighting condition and no distress signal shall be emitted until at least 47 s and at most 5 min after the satellite EPIRB has been removed manually from its release mechanism.

3.2.1.2 The satellite EPIRB shall not automatically activate when water washes over it while in its release mechanism.

3.2.2 (A.810(19)/A.2.3.2) *Be so designed that the electrical portions are watertight at a depth of 10 m for at least 5 min. Consideration* shall *be given to a temperature variation of 45 °C during transitions from the mounted position to immersion. The harmful effects of a marine environment, condensation and water leakage* shall *not affect the performance of the beacon.*

3.2.3 (A.810(19)/A.2.3.3) *Be automatically activated after floating free* or when floating in the water, irrespective of the settings of any control.

Manual deactivation shall not prevent automatic activation of the satellite EPIRB when automatically released from its release mechanism or when floating in the water.

3.2.4 (A.810(19)/A.2.3.4) *Be capable of* repetitive *manual activation and manual deactivation.*

When the satellite EPIRB is manually activated, the low-duty cycle light (see 3.2.11) shall begin flashing within 2 s, in any lighting condition, and no distress signal shall be emitted until at least 47 s and at most 5 min after the satellite EPIRB has been manually activated.

3.2.5 (A.810(19)/A.2.3.5) *Be provided with means to indicate that signals are being emitted*.

3.2.6 (A.810(19)/A.2.3.6) *Be capable of floating upright in calm water and have positive stability and sufficient buoyancy in all sea conditions*.

3.2.7 (A.810(19)/A.2.3.7) *Be capable of being dropped into the water without damage from a height of 20 m.*

3.2.8 (A.810(19)/A.2.3.8) *Be capable of being tested, without using the satellite system, to determine that the* satellite *EPIRB is capable of operating properly.* When the self-test mode (C/S T.001) is activated, the satellite EPIRB shall emit a single burst which shall always provide the beacon 15 Hex ID. For location protocol beacons, the content of the encoded position data field of the self-test message should be the default values specified in (C/S T.001) the frame synchronization pattern shall be "011010000" (i.e. the last eight bits are complemented so that this test burst will not be processed by the satellite equipment and the burst duration shall be 440 ms or 520 ms*).* Successful completion of the test shall be indicated. Activation of the test facility shall reset automatically. Any transmission in the self-test mode shall be limited to one burst. If the 121,5 MHz auxiliary radio-locating device signal is transmitted during the self test, it should not exceed 3 audio sweeps or 1 second, whichever is greater.

3.2.9 (A.810(19)/A.2.3.9) *Be of highly visible yellow/orange colour and be fitted with retro-reflecting material.*

A band of retro-reflective material, at least 25 mm wide, encircling that part of the satellite EPIRB's body which is normally protruding above the water-line, shall be acceptable.

The retro-reflective material shall also meet the performance requirements of IMO Resolution A.658(16) annex 2.

3.2.10 (A.810(19)/A.2.3.10) *Be equipped with a buoyant lanyard*, firmly attached to it, *suitable for use as a tether* for survivors or from a survival craft in the water. *It* shall *be so arranged as to prevent its being trapped in the ship's structure when floating free*.

The buoyant lanyard shall have a length of 5 m to 8 m. The breaking strength of the lanyard and its attachment to the satellite EPIRB shall be at least five times the weight of the satellite EPIRB.

3.2.11 (A.810(19)/A.2.3.11) *Be provided with a low-duty cycle light* (of at least effective *0,75 cd) active during darkness* or operating continually, and flashing at a rate of 20 to 30 times per minute, with a flash duration of between 10^{-6} s and 10^{-2} s *to indicate its position for the nearby survivors and rescue units.*

The light shall be mounted so that it is visible over as great a portion of the upper hemisphere as is practical.

3.2.12 Including the labelling, (A.810(19)/A.2.3.12) *not be unduly affected by sea water or oil or both; and* (A.810(19)/A.2.3.13) *be resistant to deterioration in prolonged exposure to sunlight.*

3.2.13 (A.810(19)/A.2.3.14) *Be provided with a 121,5 MHz beacon primarily for homing by aircraft.*

3.2.14 Be designed so that in C/S T.001*) the continuous emission failure mode, continuous transmission shall not exceed 45 s.*

3.2.15 Have all controls of sufficient size for simple and satisfactory operation and also be capable of being operated by a person wearing a survival suit as defined by SOLAS 74 as amended, III, 38.2.3.

3.2.16 Be provided with means to indicate that the satellite EPIRB has been previously activated, to advise the users of a possible reduction of the required battery capacity. These means shall not be capable of reset by the user.

For instance, manual activation of the satellite EPIRB shall break a seal which shall not be replaceable by the user. This seal shall not be broken when using the self-test facility.

3.2.17 (A.810(19)/A.3.1) *When the satellite EPIRB is manually operated a distress alert* shall *be initiated only by means of a dedicated distress alert activator.*

3.2.18 (A.810(19)/A.3.2.1) *The dedicated activator* shall *be clearly identified*

3.2.19 (A.810(19)/A.3.2.2) *The dedicated activator* shall *be protected against inadvertent operation.*

3.2.20 (A.810(19)/A.3.3) *Manual distress alert initiation* shall *require at least two independent actions.*

3.2.21 (A.810(19)/A.3.4) *The satellite EPIRB* shall *not be automatically activated after being manually removed from the release mechanism.*

The float-free arrangement shall:

3.2.17 (A.662(16)/2.1) *Be designed so that the release mechanism* shall *operate before reaching a water depth of 4 m in any orientation.*

3.2.18 (A.662(16)/2.3) *Be constructed of non-corrosive compatible materials, so as to prevent deterioration which may cause any malfunction of the unit. Galvanizing or other forms of metallic coating on parts of the float-free release mechanism* shall *not be accepted*.

3.2.19 (A.662(16)/2.4) *Be constructed to prevent release when seas wash over the unit.*

3.2.20 (A.662(16)/2.5) Including the labelling, *not be unduly affected by seawater or oil or prolonged exposure to sunlight.*

3.2.21 Have its release mechanism fitted with adequate means to prevent its inadvertent activation.

Moreover:

3.2.22 (A.662(16)/3) *For* the satellite EPIRB *requiring external power or data connection, or both, the means of connection* shall *not inhibit the release* from the release mechanism *or activation of* the satellite EPIRB.

3.2.23 (A.662(16)/4) *It* shall *be possible to assess the proper functioning of the automatic release mechanism by a simple method without activation of* the satellite EPIRB.

3.2.24 (A.662(16)/5) *It* shall *be possible to release* the satellite EPIRB *manually from the float-free mechanism*, without tools.

3.3 Environment

(A.810(19)/A.2.5) *The satellite EPIRB* shall *be so designed as to operate under any of the following environmental conditions:*

3.3.1 Ambient temperatures of -40 °C to +55 °C for class 1.

Ambient temperatures of -20 °C to +55 °C for class 2.

3.3.2 *Icing.*

3.3.3 (A.810(19)/A.2.5.3)*Relative wind speeds up to 100 knots* (52 m/s).

3.3.4 *After stowage at temperatures between* -40 °C and +70 °C for class 1 and *between -30 °C and +70 °C* for class 2.

3.3.5 (A.810(19)/A.2.6.2) *Be capable, while mounted on board, of operating properly over the ranges of shock and vibration and other environmental conditions normally encountered above deck on sea-going vessels*.

The float-free arrangement shall:

3.3.6 (A.662(16)/2.2) *Be capable of operating throughout the temperature range of* -40 °C to +65 °C for class 1 and *-30 °C to +65 °C* for class 2.

3.3.7 (A.662(16)/2.6) *Be capable of operating properly after exposure to shock and vibration and other severe environmental conditions encountered above deck on seagoing vessels.*

3.3.8 (A.662(16)/2.7) *If the ship navigates in areas where icing may be expected, be so designed as to minimize the formation of ice and prevent its effects from hindering the release of the* satellite EPIRB *as far as practicable*.

3.4 Interference

The equipment shall be in accordance with the appropriate section of IEC 60945.

3.5 Maintenance

(A.702(17)/3.2) *It should be recognized that, despite the use of other methods, some reliance on shore-based maintenance to ensure the availability of the functional requirements of the GMDSS will always be necessary*.

As defined in 3.1.7, the satellite EPIRB is a single integral unit, which is not suited for on-board repairs.

As a consequence, the equipment shall be so constructed that it is readily accessible for inspection and testing purposes only.

3.6 Safety precautions

All practicable steps shall be taken to ensure that the equipment is in accordance with the appropriate sections of IEC 60945.

In addition, the battery shall not release toxic or corrosive products outside the satellite EPIRB during or subsequent to storage at temperatures between -55 °C and +75 °C, and:

a) during a full or partial discharge at any rate up to and including an external short circuit;

b) during a charge or forced discharge of a cell or cells by another cell or cells within the battery;

c) after a full or partial discharge.

The satellite EPIRB shall include measures to protect the batteries from reversal of polarity, shorting, and the effects of self-heating, cell-to-cell charging, and forced discharging.

Moreover, care shall be taken that the satellite EPIRB and specially the battery shall not be hazardous to any person handling, using or performing manufacturer approved servicing of the device or to any vehicle or equipment in which it is transported, housed or installed under any of the conditions specified in this standard.

3.7 Equipment manuals

Adequate information, as needed to comply with 3.5 and 3.9, shall be provided to enable the equipment to be properly stowed, installed, operated and tested.

3.8 Labelling

The label shall be placed on the satellite EPIRB itself and on its container, if any, as needed.

(A.810(19)/A. 4) *In addition to the items specified in IMO Resolution A.694(17)* 6.3 and 9 (see appropriate sections of IEC 60945) *on general requirements, the following shall be clearly indicated on the exterior of the equipment*:

3.8.1 (A.810(19)/A. 4.1) *Brief operating instructions* at least in English, to enable manual activation, deactivation and self-test (see 3.2.8).

3.8.2 A warning to the effect that the satellite EPIRB shall not be operated except in an emergency.

3.8.3 Type designation and class (see clause 1, note) as specified by the manufacturer, type of battery and (A.810(19)/A. 4.2) *expiry date for the primary battery used* (see 4.6.3). Means shall be provided to change this date when the battery is replaced

3.8.4 The name of the ship and beacon identification data:

- (A.810(19)/A. 4.3) *the identity code programmed into the transmitter* of the satellite EPIRB (i.e. hexadecimal representation of bits 26 to 85 of the digital message, as described in C/S T.001), together with the call sign or MMSI of the ship as required by the Administration and the MID ;
- country (i.e. name of country as programmed in the MID);
-

3.8.5 *The float-free arrangement* shall:

(A.662(16)/2.9) *carry a label* or labels *indicating clearly* at least in English:

- *the operating instructions for manual release*;

- the type designation;
- the satellite EPIRB class;
- the maintenance and/or replacement date for the release mechanism, if applicable.

If this label or labels are not readily visible in the installed arrangement, they shall be provided in addition, for installation close to the float-free arrangement. These instructions may in addition be shown in pictorial form.

3.9 Installation

Instructions will be included in the equipment manual to ensure that *the installed satellite EPIRB* shall:

3.9.1 (IV/7.1.6.2) Be *installed in an easily accessible position*.

3.9.2 (A.694(17)/2) *Be installed in such a manner that it is capable of meeting the requirements* of this standard.

3.9.3 (A.810(19)/A.2.6.1) *Have local manual activation; remote activation may also be provided from the navigating bridge, while the device is installed in the float-free mounting.*

3.9.4 (A.810(19)/A.2.6.3) *Release itself and float free before reaching a* water *depth of 4 m at a list or trim of any angle.*

3.9.5 (A.662(16)/2.8) *Be mounted in such a way that, after being released,* it *is not obstructed by the structure of the sinking ship.*

4 Technical characteristics

4.1 Transmitted frequency

The satellite EPIRB distress alerting signal shall be transmitted on a frequency in the 406MHz band as specified in C/S T.001

4.2 Signal and message format

The technical characteristics of the transmitted signal and the message format shall be in accordance with C/S T.001.

4.3 Distress message memory

(A.810(19)/B.3) *Provisions* shall *be included for storing the fixed portion of the distress message in the satellite EPIRB using non-volatile memory*.

4.4 Beacon identification code

(A.810(19)/A.4) *A unique beacon identification code shall be made part of all messages.*

This identification code shall *include a 3-digit code for the country in which the beacon is registered, followed by either:*

.1 the trailing 6 digits of the ship station identity in accordance with Appendix 43 of ITU Radio Regulations; or

.2 a unique serial number; or

.3 a radio call sign.

Preference is given to method .1.

4.5 121,5 MHz homing signal

(A.810(19)/B.5) *The 121,5 MHz homing signal* shall:

a) have a continuous duty cycle except that it may be interrupted for up to a maximum of 2 s during the transmission of the 406 MHz signal;

b) with the exception of the sweep direction, meet the technical characteristics from appendix 37A of the Radio Regulations. The sweep may either be upward or downward.

4.6 Power source

4.6.1 (A.810(19)/A.2.4) *The battery* shall *have sufficient capacity to operate the satellite EPIRB for* an uninterrupted *period of at least 48 h,* under the extreme operating temperature conditions corresponding to the class of the satellite EPIRB.

4.6.2 The life of the battery as defined by its expiry date shall be at least three years.

The expiry date of the battery shall be the battery manufacturing date plus no more than half the useful life of the battery.

The useful life of the battery is defined as the period of time after the date of battery manufacture that the battery will continue to meet the input power requirements of the satellite EPIRB.

To define the useful life of the battery, the following losses at the temperature of +20 °C ± 5 °C shall be included:

a) self-testing, as recommended by the manufacturer or as required by the Administration, whichever is more demanding;

b) self-discharge of the battery;

c) stand-by loads.

4.6.3 The satellite EPIRB shall be clearly and durably marked with the battery expiry date. (see 3.8.3 and 4.6.2).

4.6.4 It shall not be possible to connect the battery with the polarity reversed.

4.6.5 The satellite EPIRB shall be designed such that the electronic and electrical components are not damaged in the event of a leaking battery.

4.7 Antenna characteristics (C/S T.001)

Elevation: *5° to 60°*

Pattern: *hemispherical*

Polarization: *circular (RHCP) or linear*

Gain (vertical plane): *between -3 dBi and 4 dBi over 90 % of the above region*

Gain variation (azimuth plane): *<3 dB*

5 Methods of testing and required test results

5.1 General

5.1.1 The requirements of this clause are in addition to the COSPAS-SARSAT requirements for type approval, as per COSPAS-SARSAT documents C/S T.001 and T.007, as amended. Tests shall be normally carried out at test sites accepted by the type approval authority. The manufacturer shall, unless otherwise agreed, set up the equipment and ensure it is operating

normally before testing commences. If the test site accepted by the type approval authority is also an accepted COSPAS-SARSAT test facility, both series of tests may be combined.

The COSPAS-SARSAT tests consist of the following:

a) electrical and functional tests at constant temperatures (minimum, ambient and maximum);
b) thermal shock test;
c) operating lifetime at minimum temperatures;
d) frequency stability test with temperature gradient;
e) satellite qualitative tests;
f) antenna tests;
g) beacon coding software;
h) navigation system.

(See annex B for details.)

5.1.2 Electrical power shall be supplied during performance tests normally by the batteries which form a part of the equipment. For type-approval tests, a minimum of three sets of batteries shall be submitted.

5.1.3 For the purpose of this standard a "performance check" consists of a test based upon 5.1.14.

5.1.4 The requirements of this standard shall be met (C/S T.001) after a maximum warm-up period of 15 min.

5.1.5 Adequate information shall be provided to enable the equipment to be properly set up, maintained and operated during the type testing.

5.1.6 (3.1.6) If the equipment contains any additional facilities such as an E.P.F.E (Electronic Position Fixing Equipment) or the possibility of connecting external data, they shall be operational for the duration of all tests, except if specified otherwise.

5.1.7 During testing all audible and visual indications including the low-duty cycle light shall be operational.

5.1.8 *Preparation of satellite EPIRB for type-approval testing*

5.1.8.1 For the purpose of performance testing, the satellite EPIRB shall be specially programmed to transmit data bursts encoded using (C/S T.007) *the test protocol of appropriate type and format*, when the satellite EPIRB is activated:

Evidence of compliance with all the requirements of 5.1.8 and 3.1.2 shall be submitted by the manufacturer before testing commences.

5.1.8.2 (C/S T.007- 4.3 test units) The satellite EPIRB shall be configured such that the antenna port can be connected to the test equipment by a coaxial cable terminated by a 50 Ohm load. The configuration of the antenna port can be prepared by the manufacturer before the first test or before test of the list of tests A1.14 given in annex A. All tests up to A1.14, except test A1.10 shall be performed with the antenna in place. (See annex A for the required sequence of tests.) Test A1.10 is to be performed with the beacon operating into 50 Ohm load.

5.1.8.3 One or more other satellite EPIRBs may be used instead of the satellite EPIRB referred to in 5.1.8.1 for tests A2.1 to A2.6 as listed in annex A. In that case, they shall also be encoded as per 5.1.8.1.

5.1.9 All homing devices shall be prepared for test transmission as required by the national authority. Care shall be taken not to transmit distress signals on distress and safety frequencies, for example, by frequency offset.

5.1.10 Test conditions

Tests shall be carried out under normal test conditions, unless otherwise stated.

5.1.11 Normal test conditions

Normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

Temperature:	+15 °C to +35 °C
Relative humidity:	20 % to 75 %

5.1.12 Extreme test conditions

For tests at extreme temperatures, measurements shall be made in accordance with the procedure specified in IEC 60945.

Applicable temperature ranges:

For class 1:	-40 °C to +55 °C
For class 2:	-20 °C to +55 °C

5.1.13 Test sequence

All tests shall be performed on a single equipment, configured as per 5.1.8.1. The tests shall be carried out in the order defined in annex A of this standard. Alternatively, one equipment configured as per 5.1.8.1 may be used for tests A1.1 to A1.14 of annex A and another or other ones for tests A2.1 to A2.6.

5.1.14 Performance check

A performance check consists in activating the satellite EPIRB (see 5.1.8.1) and checking the integrity of the complete digital message within 15 min, as defined in 4.2.

5.2 Operational requirements

The requirements of clause 3 shall be verified as follows (the subclause is in brackets):

5.2.1 (3.2.1) By inspection.

5.2.1.1 (3.2.1.1) By inspection.

5.2.1.2 (3.2.1.2) Test included in 5.2.19.

5.2.2 (3.2.2) Test included in 5.4.4.4 and 5.4.4.8.

5.2.3 (3.2.3) The satellite EPIRB shall be floated in a 0,1 % salt solution and shall activate irrespective of the settings of any control. The test will be repeated for any combination of settings of controls.

The salt used for the test shall be sodium chloride (NaCl) containing, when dry, not more than 0,1 % sodium iodide and 0,03 % total impurities.

The salt solution concentration shall be (0,1 ± 0,01) % by weight.

The solution shall be prepared by dissolving 1 ± 0,1 parts by weight of salt in 1 000 parts by weight of distilled or demineralized water.

This test may be combined with the test in 5.2.17.

5.2.4 (3.2.4) By inspection.

5.2.5 (3.2.5) By inspection.

5.2.6 (3.2.6)

5.2.6.1 With the antenna deployed in its normal operating position, the satellite EPIRB shall, when rotated to a horizontal position about any axis, be submerged in fresh water just below the surface, and when released pass through an upright position within 2 s.

NOTE - Fresh water is defined as normal domestic tap water.

5.2.6.2 In calm fresh water, the satellite EPIRB shall float upright with the base of the antenna a minimum of 40 mm above the water-line.

5.2.6.3 The reserve buoyancy of the satellite EPIRB shall be at least 5 % when determined by one of the following methods:

a) The complete unit shall be submerged and the buoyant force shall be measured with a scale. The buoyant force shall be divided by the weight of the unit. The result shall be at least 1,05.
b) The location of the water-line shall be determined on the floating satellite EPIRB. The calculated or measured volume of the unit above the water-level shall be divided by the calculated or measured volume below the water-level. The result shall be at least 1,05.

5.2.7 (3.2.7) Test included in 5.4.4.5.

5.2.8 (3.2.8) The self-test mode of the satellite EPIRB shall be activated. The digital message generated shall be in accordance with the requirements of 3.2.8 (self-test *frame synchronization*).

The automatic reset of the test facility and the indication of the self-test mode shall be checked by inspection.

5.2.9 (3.2.9) By inspection of the fitting and of evidence of compliance with IMO Resolution A.658(16) for the performance requirements of the retro-reflective material.

5.2.10 (3.2.10) By inspection of evidence submitted by the manufacturer that the lanyard meets the specified requirements.

5.2.11 (3.2.11) The effective luminous intensity and flash rate shall be checked at the normal temperature and at the extreme temperatures. The effective luminous intensity shall be defined by the following formula as indicated in IMO Resolution A.689(17) - Testing of life-saving appliances, 10.2.2:

$$\frac{\int_{t_1}^{t_2} i \cdot dt}{0.2 + (t_2 - t_1)}$$

where:

i is the instantaneous intensity;

0,2 is the Blondel-Rey constant;

t_2 - t_1 are the time limits of integration in seconds.

The effective luminous intensity shall be at least 0,75 cd. The flash rate shall be 20 to 30 times per minute.

NOTE - Where the tests required at extreme temperature cannot be carried out within the environmental chamber, other methods may be used which approximate the required conditions.

5.2.12 (3.2.12) By inspection of the evidence submitted by the manufacturer that the materials used, including any coloured external coating, are unlikely to be affected adversely by seawater or oil or prolonged exposure to sunlight.

5.2.13 (3.2.13) By inspection.

5.2.14 (3.2.14) By inspection.

5.2.15 (3.2.15) By inspection

5.2.16 (3.2.16) By inspection of the evidence submitted by the manufacturer and of the satellite EPIRB.

5.2.17 (3.1.4, 3.1.5, 3.2.17 and 3.3.8). The satellite EPIRB installed in the automatic release mechanism shall be submerged in water, at normal temperature for all tests. The water temperature shall be noted. The following tests may be performed in any sequence.

The test at normal temperature shall be performed six times with the equipment rotated each time as follows:

- normal mounting position (as defined in the equipment manual, see 3.7);
- rolling 90° to starboard;
- rolling 90° to port;
- pitching 90° bow down;
- pitching 90° stern down;
- upside-down position.

The satellite EPIRB shall be automatically released and float free of the mounting before reaching, at any orientation, a depth of 4 m or, at a water pressure equivalent to that depth, namely 40 kPa.

The test at the extreme temperatures shall be performed in the normal mounting position(s) only, as defined in the equipment manuals.

NOTE - Where the tests required at extreme temperatures cannot be carried out within the environmental chamber, other methods may be used which approximate the required conditions.

(See 3.3.6.) Any climatic control devices provided in the equipment may be switched on before or during the test.

The inspection test as described in 5.4.2 shall be effected after each release from the satellite EPIRB from its float-free mechanism.

The performance check as described in 5.1.14 shall be carried out after each series of releases and at each specified temperature.

5.2.18 (3.2.18) By inspection of the evidence submitted by the manufacturer that the materials used, including any coloured external coating, are unlikely to cause any malfunction of the unit.

5.2.19 (3.2.19 and 3.2.1.2) The unit consisting of the satellite EPIRB and its release mechanism installed in its bracket, if any, shall be mounted, on a suitable test fixture, successively in each method intended for mounting on a ship, as described in the equipment manual. A stream from a hose shall be directed at the unit for a period of 5 min. The nozzle of the hose shall have a nominal diameter of 63,5 mm and a water-delivery rate of approximately 2 300 l of water per minute. The end of the nozzle shall be 3,50 m away from the satellite EPIRB and 1,50 m above the base of the antenna. The nozzle or the unit shall be moved during the test, so that water strikes the satellite EPIRB in an arc of at least 180° perpendicular to the normal mounting position of the unit.

The satellite EPIRB shall not release from its bracket nor shall it automatically activate as a result of the water from the hose stream.

5.2.20 (3.2.20) By inspection, including the labelling, of the evidence submitted by the manufacturer that the materials used are unlikely to be duly affected by seawater or oil or prolonged exposure to sunlight.

5.2.21 (3.2.21) Test included in 5.2.19

5.2.22 (3.2.22) By inspection.

5.2.23 (3.2.23) By inspection.

5.2.24 (3.3.2/3.3.8) If the manufacturer declares conformance with 3.3.2/3.3.8 by successful completion of 5.2.17 at the extreme temperature, and by inspection of the equipment manual to confirm fitting of heaters, or suitable alternatives, to the float-free arrangement.

5.2.25 (3.3.3) By inspection of the evidence submitted by the manufacturer, and by successful completion of 5.2.19.

5.2.26 (3.5) By inspection.

5.2.27 (3.6) By inspection of the evidence submitted by the manufacturer that the satellite EPIRB and the battery shall function safely under the conditions stated in 3.6.

5.2.28 (3.7) By inspection of the equipment manuals.

5.2.29 (3.8) By inspection.

5.2.30 (4.6.4) By inspection.

5.2.31 (3.9) By inspection of the equipment manuals and, if provided, by activation of the satellite EPIRB from the remote system, set up according to manufacturer's instructions.

5.3 Battery capacity

(4.6.1) *Battery capacity and low-temperature test.*

5.3.1 Using a fresh battery pack, the satellite EPIRB shall be activated (at the ambient temperature) for a period of time as stated by the manufacturer to be equivalent to the loss of battery capacity due to self-testing, stand-by loads as well as battery-pack self-discharge during the useful life of the battery pack (as defined in 4.6.2). The manufacturer shall substantiate the method used to determine this time.

5.3.2 The satellite EPIRB shall be placed in a chamber of normal room temperature. Then the temperature shall be reduced to and maintained at -40 °C ± 3 °C for class 1 or -30 °C ± 3 °C for class 2 equipment for a period of 10 h or some such period as may be determined by the type approval authority.

5.3.3 Any climatic control device provided in the equipment may be switched on and for class 2 equipment the chamber heated to -20 °C ± 3 °C, at the conclusion of the period specified in 5.3.2. The action of the climatic control device and for class 2 equipment, the heating of the chamber shall be completed within 20 min.

5.3.4 The equipment shall be activated 30 min after the end of the period specified in 5.3.3 and shall then be kept working continuously for a period of 48 h. The temperature of the chamber shall be maintained as specified in 5.3.3 for the whole of the period of 48 h.

5.3.5 The equipment shall be subjected to the test as specified in C/S T.007, annex A, A.2.3 (Operating lifetime at minimum temperature) at intervals of not more than 6 h and at the end of the period of 48 h.

5.3.6 The satellite EPIRB shall meet the requirements of C/S T.007, annex A, A.2.3 (-40 °C for class 1 and -20 °C for class 2) for 48 h.

5.3.7 This test may be combined with the test as described in C/S T.007, annex A, A.2.3 (see annex A1.14).

5.4 Environment

5.4.1 Environmental tests are intended to assess the suitability of the construction of the equipment for its intended physical conditions of use.

5.4.2 After each environmental test (5.4.4), the equipment shall be inspected for any mechanical deterioration and/or for water penetration.

5.4.3 Before commencing the first environmental test and after each environmental test, a performance check shall be made (see 5.1.14).

5.4.4 The following tests shall be made under environmental conditions as detailed in IEC 60945. All these tests, except 5.4.4.5, Drop test into water, shall be performed with the satellite EPIRB installed in the release mechanism.

5.4.4.1 (3.3.1, 3.3.4 and 3.3.6) *Dry heat cycle of IEC 60945*

The performance check shall be replaced by the test required by C/S T.007, annex A, A.2.1 (Electrical and functional tests at constant temperature).

5.4.4.2 (3.3.1, 3.3.4 and 3.3.6) *Damp heat cycle, of IEC 60945*

5.4.4.3 *Low-temperature cycle*

This test is covered by successful completion of the test in 5.3.

5.4.4.4 (3.2.2)*Thermal shock test, of IEC 60945*

NOTE - This test is different from the thermal shock test required by C/S T.007, annex A, A.2.2, *Thermal shock test.*

Subject to a satisfactory performance check, the opening of the satellite EPIRB to check for water ingress may be delayed until the completion of all tests.

5.4.4.5 (3.2.7)*Drop test into water, of IEC 60945*

The three drops shall be initiated from a different orientation, namely antenna vertically up, antenna vertically down and antenna horizontal.

Subject to a satisfactory performance check, the opening of the satellite EPIRB to check for water ingress may be delayed until the completion of all tests.

5.4.4.6 (3.3.5, 3.3.7)*Vibration test, of IEC 60945*

The performance check as in IEC 60945 shall be carried out at the completion of the vibration test.

5.4.4.7 (3.3.5, 3.3.7)*Ruggedness test*

The ruggedness test is conducted to give a measure of confidence that the equipment will meet service conditions. The satellite EPIRB shall be secured to the testing equipment through its normal attachments or mounting intended for use in service conditions and mounted in the normal operating position(s). Additional straps or other holding means shall not be used.

The satellite EPIRB shall be subjected to the ruggedness test according to the following profile:

Peak acceleration:	98 m/s^2 ± 10 %
Pulse duration:	16 ms or 20 ms ± 10 %
Wave shape:	Half-cycle sinewave
Test axis:	Vertical
Number of bumps:	4 000

5.4.4.8 (3.2.2)*Immersion test, of IE60945*

Subject to a satisfactory performance check, the opening of the satellite EPIRB to check for water ingress may be delayed until the completion of all tests.

If the satellite EPIRB is equipped with a battery compartment which allows for user's replacement of the battery, the test shall be repeated with the battery compartment open to ensure that there is no water ingress.

Alternatively, tests may be carried out at a water pressure equivalent to a depth of 10 m, or 100 kPa.

This test may be combined with the test in 5.4.4.4.

5.4.4.9 *Corrosion test,of IEC 60945*

5.5 Interference (3.4)

All these tests shall be performed with the satellite EPIRB installed in the release mechanism.

5.5.1 Spurious emissions

The measurement shall be performed only between bursts.

The measurements shall be made at the transmitter output at 50 Ohm using a receiver or a spectrum analyser with its bandwidth set to 120 kHz or its nearest setting, over the following frequency bands:

156 MHz to 174 MHz, 1 525 MHz to 1 545 MHz

No signal level within these bands shall exceed 25 μW.

This test may be combined with the test required by C/S T.007, annex A, A.3.2.2.4 (annex A1.14)

5.5.2 Compass safe distance

The test will be in accordance with IEC 60945 with the satellite EPIRB not activated.

5.5.3 Conducted interference

If there is a connection between the ship's power system and the satellite EPIRB or its release mechanism, the equipment shall, in addition, be tested to the appropriate sections of IEC 60945.

5.6 Safety precautions (3.6)

By inspection of the evidence presented by the manufacturer.

5.7 Miscellaneous

5.7.1 (3.1.1) By inspection.

5.7.2 (3.1.6) By inspection.

Annex A
(normative)

Sequence of tests

The following environmental and operational tests shall be conducted in the sequence as stated here below. All tests shall be performed on a single unit as defined in 5.1.8.1/5.1.8.2.

Alternatively, all tests numbered A1.1 to A1.14 shall be performed on the unit defined in 5.1.8.1 and all tests numbered A2.1 to A2.6 shall be performed on one or more other unit(s) as defined in 5.1.8.3 and 5.1.13. These tests numbered A2.1 to A2.6 may be carried out independently in any sequence.

Tests marked "x" may be performed in the indicated sequence or moved in the sequence and combined with the related COSPAS-SARSAT tests (A1.14).

A performance check (see 5.1.14) shall be performed before the first test and during or after each test.

A.1 Compulsory sequence of tests

	A1.1	Message format and homing devices (see 5.1.8 and 5.1.9)
x	A1.2	Dry heat test (see 5.4.4.1 of this standard and IEC 60945)
	A1.3	Damp heat test (see 5.4.4.2 of this standard and IEC 60945)
	A1.4	Vibration test (see 5.4.4.6 of this standard and IEC 60945)
	A1.5	Ruggedness test (see 5.4.4.7)
	A1.6	Corrosion test (see 5.4.4.9 of this standard and IEC 60945)
	A1.7	Drop test into water (see IEC 60945 as modified in this standard, 5.4.4.5)
	A1.8	Thermal shock test (see 5.4.4.4 of this standard and IEC 60945)
	A1.9	Immersion test (see 5.4.4.8 of this standard and IEC 60945)
x	A1.10	Spurious emission (see 5.5.1)
	A1.11	Conducted interference test (if applicable) (see 5.5.3 of this standard and IEC 60945)
	A1.12	Signal light test (see 5.2.11)
	A1.13	Battery capacity and low-temperature test (see 5.3)
	A1.14	COSPAS-SARSAT type-approval test procedure

A.2 Additional tests

A.2.1 Test of operational requirements

Subclauses of this part:

5.2.1, 5.2.4, 5.2.5, 5.2.8, 5.2.9, 5.2.10, 5.2.12, 5.2.13, 5.2.14, 5.2.15, 5.2.17, 5.2.18, 5.2.19, 5.2.20, 5.2.22, 5.2.23, 5.2.24, 5.2.25, 5.2.26, 5.2.27, 5.2.28, 5.2.29, 5.2.30, 5.7.1, 5.7.2

A.2.2 Automatic release mechanism and automatic activation test for class 1 and class 2 satellite EPIRB's (5.2.16) This test may be combined with the test required in 5.4.4.4.

A.2.3 Stability and buoyancy test (see 5.2.6).

A.2.4 Float-free activation test (see 5.2.3).

A.2.5 Safety (see 5.6 of this standard and IEC 60945).

A.2.6 Compass safe-distance test (see 5.5.2 of this standard and IEC 60945).

Annex B
(normative)

List of COSPAS-SARSAT tests
(as defined in COSPAS-SARSAT document C/S T.007, as amended)

This standard calls up all the requirements of COSPAS-SARSAT type-approval tests without modification

The list of measurements indicated hereunder is given for reference only. The latest issue of C/S T.007shall be used.

The COSPAS SARSAT type approval is a requirement of this standard (see 3.1 and 5.1.1).

Parameters to be measured during tests

B.1 Power output

- Transmitter power output
- Power output rise time
- Power output 1 ms before burst

B.2 Digital message

- Bit synchronization
- Frame synchronization
- Format flag
- Protocol flag
- Identification / position data
- BCH code
- Emergency code/national use//supplementary data
- Additional data/BCH (if applicable)
- Position error (if applicable)

B.3 Digital message generator

- Repetition rate
- Bit rate
- Total transmission time
- Unmodulated carrier
- First burst delay

B.4 Modulation

- Biphase-L
- Rise time
- Fall time
- Phase deviation: positive
- Phase deviation: negative
- Symmetry measurement

B.5 406 MHz transmitted frequency

- Nominal value
- Short-term stability
- Medium-term stability:
  - slope
  - residual frequency variation

B.6 Spurious emissions (into 50 Ohm)

- in-band (406,0 MHz to 406,1 MHz)

B.7 406 MHz VSWR check

After open circuit, short circuit, then while VSWR is 3:1, measure:

- Nominal transmitted frequency

Modulation:

- Rise time
- Fall time
- Phase deviation: positive
- Phase deviation: negative
- Symmetry measurement
- Digital message

B.8 Self-test mode

- Frame synchronization
- Format flag
- Single radiated burst
- Default position data (if applicable)
- Description provided
- Design data provided on protection from repetitive self-test mode transmissions
- Single burst verification
- Provides for beacon 15 Hex ID

B.9 Thermal shock (30 °C change)

- Soak temperature
- Measurement temperature

The following parameters are to be met within 15 min of beacon turn-on and maintained for 2 h:

- Transmitted frequency
- Nominal value
- Short-term stability
- Medium-term stability:
  - slope
  - residual frequency variation

- Transmitter power output
- Digital message

B.10 Operating lifetime at minimum temperature

- Duration
- Transmitted frequency
- Nominal value
- Short-term stability
- Medium-term stability:
  - slope
  - residual frequency variation
- Transmitter power output
- Digital message

B.11 Temperature gradient (5 °C/h)

- Transmitted frequency
- Nominal value
- Short-term stability
- Medium-term stability:
  - slope
  - residual frequency variation
- Transmitter power output
- Digital message

B.12 Long-term frequency stability

B.13 Protection against continuous transmission

B.14 Satellite qualitative tests

B.15 Antenna characteristics

- Polarization
- ERP_{max} EOL
- ERP_{min} EOL
- Azimuth gain variation at 40° elevation angle

B.16 Beacon Coding Software

- Sample message provided for each coding option of the applicable coding protocol types
- Sample messages provided, if applicable, with encoded positions at least 5 km apart for each applicable coding protocol type
- Sample self-test message provided for each coding option of the applicable coding protocol types

B.17 Navigation System

- Position data default values

- Position acquisition time
- Encoded position data update interval
- Position data input update interval (as applicable)
- Delta offset
  - positive direction
  - negative direction
  - over-range to 2 times coarse resolution
- last valid position
  - retained after navigation input lost
  - cleared when beacon reactivated
- design data provided on protection against beacon degradation due to navigation device, interface or signal failure or malfunction

Annex C
(normative)

Standard for a manually activated satellite EPIRB without a float-free mechanism

C.1 Requirements

A non-float-free satellite EPIRB shall meet all the requirements of this standard with the exception of the following subclauses:

3.1.3, 3.1.4,

3.2.3 The satellite EPIRB shall be designed to activate when manually released from its mounting bracket and floating in the water.

3.2.16, 3.2.17, 3.2.18, 3.2.19, 3.2.20, 3.2.21, 3.2.22, 3.2.23, 3.3.6, 3.3.7, 3.3.8, 3.8.5, 3.9.3, 3.9.4, 3.9.5.

Annex D
(normative)

Technical standard for 121,5 MHz homing device

D.1 General

This annex specifies the operational and performance requirements, technical characteristics and methods of testing of a shipborne 121,5 MHz homing device, which forms part of the satellite emergency indicating radio beacon used in the COSPAS-SARSAT satellite system (satellite EPIRB) and described in this standard.

D.2 Performance requirements

D2.1 (A.810(19), annex, Part A, 2.3.14) *Be provided with a 121,5 MHz homing beacon*.

D2.2 (A.810(19), annex, Part B, 5) *The 121,5 MHz homing signal* shall

a) *have a continuous duty cycle except that it may be interrupted for up to a maximum of 2 s during the transmission of the 406 MHz signal;*

b) *with the exception of the sweep direction, meet the technical characteristics from appendix 37A of the Radio Regulations. The sweep may be either upward or downward*.

D.3 Technical characteristics

D3.1	Carrier frequency	121,5 MHz ± 50 ppm
D3.2	Peak effective radiated power (PERP)	+17 dBm (50 mW) ± 3 dB[1]
D3.3	Transmitter duty cycle	100 % (see D.2.2.1)
D3.4	Modulation	Amplitude modulated (3K20A3X)

D3.4.1 (690) The A3X emission shall *include a clearly defined carrier frequency distinct from the modulation sideband components; in particular, at least 30 % of the total power emitted during any transmission cycle with or without modulation* shall *be contained within ±30 Hz of the carrier frequency. Additionally, if the type of emission is changed during transmission, the carrier frequency shall not shift more than ±30 Hz from the carrier frequency*.

D3.4.2 Modulation frequency within the range 300 Hz to 1 600 Hz — An audio signal swept upward or downward ≥ 700 Hz

D3.4.3 Modulation duty cycle — 33 % to 55 %

D3.4.4 Modulation factor — Between 0,85 and 1,0

D3.4.5 Sweep repetition rate — 2 Hz to 4 Hz

D3.5 Spurious emissions — See figure D1

[1] Peak-effective radiated power (PERP) is the power supplied to the antenna by the transmitter (measured at the highest crest of the modulation envelope) multiplied by the relative gain of the antenna in a given direction.

D3.6 Antenna

D3.6.1 Pattern Essentially omnidirectional in the horizontal plane

D3.6.2 Polarization Vertical

D3.7 Environment Shall meet the requirements of 3.3 of this standard

D3.8 Minimum operating lifetime 48 h throughout the specified operating temperature range

D.4 Methods of testing and required test results

Unless otherwise specified, all transmitter signal characteristics shall be measured at the minimum and maximum operating temperatures.

For the purpose of testing outside a screened room, the equipment shall be prepared as required by 5.1.9.

The tests may be performed in any sequence and in conjunction with other electrical tests. In all cases, the tests shall be conducted after the satellite EPIRB has been temperature stabilized for at least 1 h and has been ON for at least 15 min. Unless otherwise specified, the test shall be performed with modulation present.

D4.1 (4.1)Carrier frequency

The carrier frequency test may be performed with a frequency counter or a spectrum analyser. The carrier frequency, measured at the minimum and maximum operating temperatures, shall be 121,5 MHz ± 50 ppm.

D4.2 (4.2/4.3 and 4.8)Peak effective radiated power

This test is only required to be performed at ambient temperature and shall use a satellite EPIRB whose battery has been ON for a minimum of 44 h.

If the test exceeds 4 h, the battery may be replaced by another which has been pre-conditioned with at least 44 h of ON time.

The measurement procedure consists in a determination of 12 values of PERP made by direct measurement of radiated power.

The measurements are taken at an azimuth angle of 30° ± 3°. All PERP measurements shall be made at the same elevation angle; the elevation used shall be the angle between 5° and 20° for which the satellite EPIRB exhibits a maximum antenna gain. The median value of PERP shall be between 25 mW and 100 mW; the ratio of maximum to minimum of the 11 highest values of PERP shall not exceed 4 to 1 (6 dB).

D4.2.1 Radiated power test condition

The test site shall be on level ground, which has uniform electrical characteristics. The site shall be clear of metal objects, overhead wires, etc., and as free as possible from undesired signals such as ignition noise or RF carriers. The distance from the satellite EPIRB, or the search antenna shall be at least 30 m. The satellite EPIRB shall be placed in the centre of a ground plane with a radius of no less than 75 cm ± 5 cm.

It shall be positioned vertically such that the ground plane is at the nominal waterline. The ground plane shall be resting on ground level and shall be extended so that it completely encloses and presents a snug fit to the portion of the satellite EPIRB which is below the water-line.

Measurement of the radiated signals shall be made at a point 5 m or more from the satellite EPIRB. At this point, a wooden pole or insulated tripod with a movable horizontal boom shall be arranged so that a search antenna can be raised and lowered through an elevation angle of 5° to 20°. The search antenna shall be mounted on the end of the boom with its cable lying horizontally on the boom and run back to the supporting mast. The other end of the search antenna cable shall be connected to a spectrum analyser located at the foot of the mast.

D4.2.2 Method of measurement

The elevation angle between 5° and 20° which produces a maximum gain is determined with the satellite EPIRB at an arbitrary azimuth. The PERP shall be measured and the elevation angle noted and shall remain fixed for the remainder of the test. The remaining 11 measurements of PERP may be obtained by rotating the satellite EPIRB in increments of 30° ± 3°. For each measurement, the satellite EPIRB PERP shall be computed using the following equation:

$$PERP = LOG^{-1}\frac{P_{REC} - G_{REC} + L_c + L_P}{10}$$

where:

P_{REC} is the measured power level from spectrum analyser (dBm);

G_{REC} is the antenna gain of search antenna (dB);

L_c is the receive system attenuator and cable loss (dB);

L_p is the free space propagation loss (dB).

D4.3 (4.3)Transmitter duty cycle

The transmitted signal shall be observed on a suitable test instrument and it shall be determined that the carrier is not interrupted, with the exception of up to 2 s during transmission of the 406 MHz signal.

D4.4 (4.4)Modulation characteristics

The transmitter duty cycle, modulation frequency, modulation duty cycle, modulation factor, and sweep repetition rate shall be determined by the method now described, by observing the detected RF signal with a storage oscilloscope. All measurements shall be made at the minimum and maximum operating temperatures.

D4.4.1 (4.4.2/4.4.5)Modulation frequency and sweep repetition rate

The modulation envelope shall be observed and the upper and lower audio-frequency sweep limits and sweep repetition rate shall be determined. The limits and rate shall meet the requirements of D3.4.2 and D3.4.5 respectively.

D4.4.2 (4.4.3)Modulation duty cycle

Modulation duty cycle is the ratio of the positive modulation peak duration to the period of the instantaneous fundamental audio-modulation frequency, observed at the half-amplitude points on the modulation envelope using the following formula (see figure D2a):

$$Duty\ cycle = \frac{A}{B} \times 100\%$$

The modulation duty cycle shall be measured near the start, midpoint, and end of the modulation period.

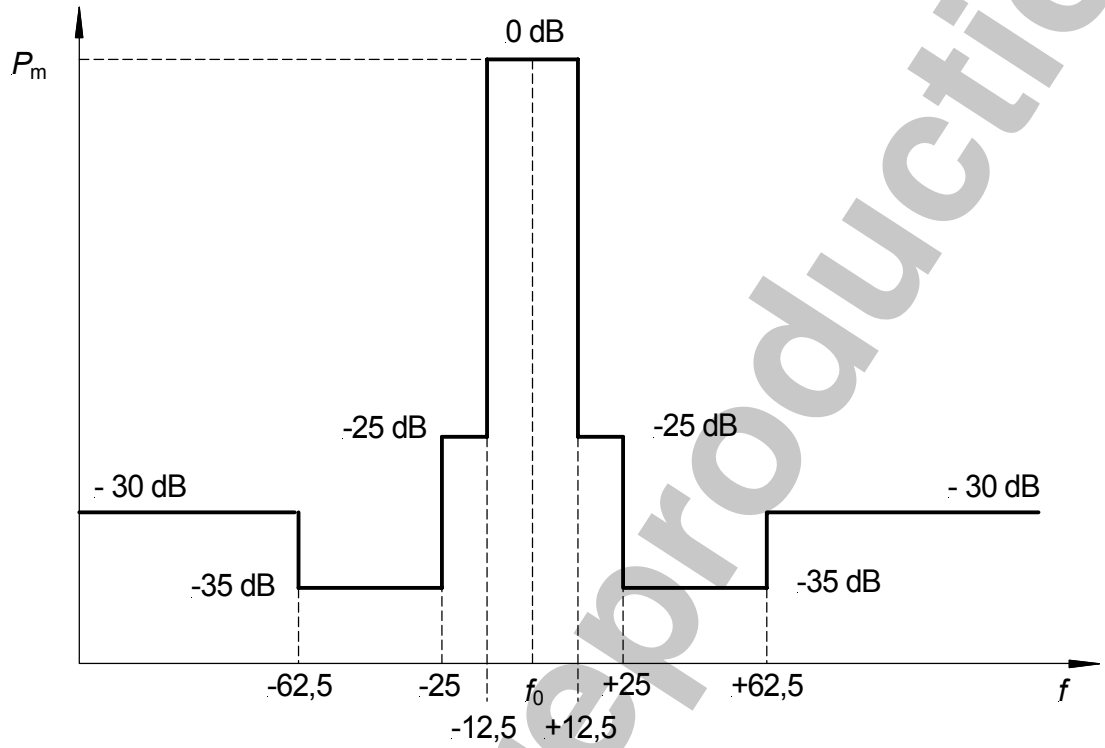
The duty cycle shall meet the requirements of D3.4.3.

D4.4.3 (4.4.4)Modulation factor

The modulation factor shall be defined with respect to the maximum and minimum amplitudes of the modulation envelope by the following formula (see figures D2b and D2c):

$$Modulation\ factor = \frac{A - B}{A + B}$$

The modulation factor shall meet the requirements of D3.4.4.



Relative frequency of 121,5 MHz homing device in kHz

P_m = Mean power

P_m = *D(PERP)* power output of 121,5 MHZ homing device

D = Modulation duty cycle

PERP = Peak effective radiated power

Figure D1 - Spurious emission mask for 121,5 MHz signal

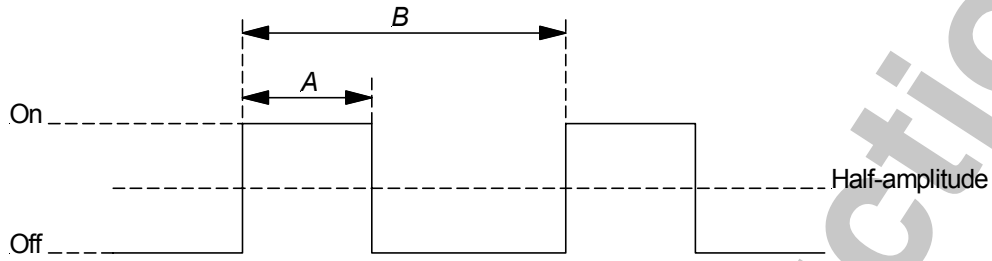


Figure D2a - Typical modulation waveform

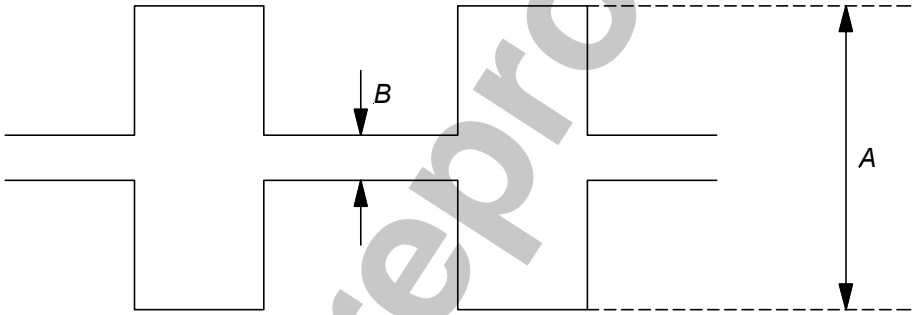


Figure D2b - Typical full-wave modulation envelope

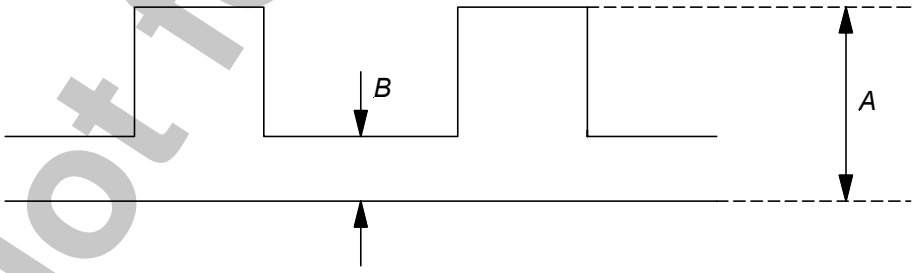


Figure D2c - Typical one-half-wave modulation envelope

Figure D2

Annex E
(informative)

User experience of COSPAS-SARSAT EPIRB operation

Since the GMDSS amendments to the SOLAS Convention were agreed in 1988, considerable experience has been gained at sea in the use of various components of the system, in advance of the dates for mandatory implementation on board Convention ships.

This has led to significant problems concerning the detailed interpretation of the relevant IMO Resolutions.

This standard had been developed with the experience of some years of operation of COSPAS-SARSAT EPIRBs aboard ships. The IMO requirement that the satellite EPIRB be automatically activated after floating free has been interpreted to mean "automatic activation" whenever the satellite EPIRB is floating in the water, irrespective of the settings of any controls. This is in response to numerous accidents that have occurred around the world where satellite EPIRB's have successfully floated free but then not operated as they have been switched off or otherwise disarmed. The IMO requirement that the satellite EPIRB be capable of being tested is interpreted to mean that the satellite EPIRB emits the C/S T.001defined self-test signal. This enables ship surveyors and shore based maintenance providers to take advantage of portable receiver/decoders to attain greater confidence that the satellite EPIRB is fully operational. It is considered that this then satisfies the IMO requirement that means are provided to indicate that signals are being emitted. An audible or visual indicator on the satellite EPIRB for this purpose would not give a very positive indication to a survivor unaware of the workings of COSPAS-SARSAT, as this indicator would only operate for a half-second every 50 s or so. However, this standard requires that the strobe light fitted begins flashing within 2 s of satellite EPIRB activation, whether by manual or automatic means, to give immediate warning of inadvertent activation or immediate confidence of successful activation.

Experience has shown that satellite EPIRBs are often not robust enough in service to remain operational between the life of the battery (changed every four years). As a consequence, a ruggedness test has been included consisting of 4 000 98 m/s^2 (10 *g*) bumps. Additionally, the hose test called up by IMO for life-raft canopy closure (A.689(17),5.12) has been included to test the strength of the release bracket. The lanyard required by IMO is defined to have a length of between 5 m and 8 m. It is hoped that this will restrict the use of the lanyard to the intended purpose of a towing-line from a survival craft in the water. There have been numerous cases of the lanyard being used to tether the satellite EPIRB to the vessel which then has prevented the automatic float-free operation.

Satellite EPIRBs are designed to operate floating in water; where satellite EPIRBs are operated in their brackets, or inside a survival craft, the satellite EPIRB may have reduced performance.

A recommended practice is that:

the satellite EPIRB should be placed in the water and tethered to the survival craft. Satellite EPIRBs which are not meant to float in water should be placed in the survival craft in a vertical position with the antenna clear of all obstacles, including close proximity of human bodies;

in the case of satellite EPIRBs incorporating an internal navigation device, the EPIRB should be operated outside enclosures, such as a carbon-fibre vessel hull, which could prevent acquisition of navigational satellite signals by the satellite EPIRB’s navigation receiver.

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